REMARKS

This amendment is submitted in response t the Office Action dated March 8, 2001.

The claims have been amended to more particularly point out and distinctively claim the invention. Claim 14 has been amended to recite a method of combusting a propellant wherein a propellant with specific characteristics is provided. Claims 14 and 15 has been amended to add the parenthesis in the denominator for the units of a_{onset}, consistent with that shown in the specification at page 33. The equation of a_{onset} has been amended to define certain of the terms. Specifically, the variable C_{fref} is replaced with the value 0.03. C_{fref} is a constant and support for this change is found in the specification at page 19, line 14. Additionally, the variable C_{B1} is amended to further define C_{B1} with reference to equation 11. Support for this change is found in the specification at page 19, lines 18 to 21. Claims 16-19, and 21 have been amended to correct minor informalities. Claims 20 and 48 have been cancelled. New claim 49 is added to further claim the features of the present invention. Specifically, claim 49 recites the viscosity and surface tension values of the liquid layer which promote entrainment of droplets into the oxidant which increases the regression rate. Support for these values can be found in the specification, for example at page 39 in originally filed claim 4.

The Examiner rejects claims 14-21 and 48 under 35 U.S.C §112, second paragraph, as being indefinite. Applicant respectfully submits that the claims as amended are now definite.

The Examiner rejects claims 14-21 and 48 under 35 U.S.C. §101 as being directed to non-statutory subject matter. Applicant respectfully submits that the claimed invention is directed to statutory subject matter and is patentable. MPEP 2106(II)(A) states:

> Office personnel have the burden to establish a *prima facie* case that the claimed invention as a whole is directed to solely an abstract idea or to manipulation of abstract ideas or does not produce a useful result. Only when the claim is devoid of any limitation to a practical application in the technological arts

should it be rejected under 35 U.S.C. 101.

The claimed invention clearly recites method steps which pr vide a practical application in the technological arts and which produce a useful, concrete and tangible result; i.e. the combustion of a certain provided propellant which exhibits specific characteristics that promote entrainment of droplets from a liquid layer formed on the propellant. This entrainment mechanism is found to greatly improve the regression rate of the propellant, which provides for the practical use of hybrid rocket systems.

The Examiner next rejects claims 14-21 and 48 under 35 U.S.C. 112, first paragraph, as being non-enabling. Applicant respectfully submits that the claimed invention is clearly enabled, and that an enabling disclosure is provided. The propellant selection method is clearly described in the specification, for example at pages 15 to 24. The entrainment onset parameter a_{onset} is clearly described for example at pages 21 to 24, and the values where entrainment will occur are shown on page 22. Applicant respectfully submits that those of skill in the art can calculate the entrainment onset parameter for materials of interest given the teaching of the present invention. Once that parameter is known, it is then compared with the values given in equation 18, page 22, to predict whether entrainment is likely to occur.

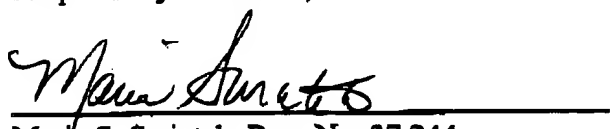
The claims as amended provide a basis for the engine parameters in the equation. Specifically, C_{fref} has been replaced by a constant value, and C_{Bl} has been further defined by an equation 11 having variable B, where B is $0 < B < 15$. Applicant respectfully submits that proper antecedent basis has been provided to correlate the properties of the propellant that are determined in calculating the equations in claim 14.

Many working examples are provided to give further guidance and direction for practicing the invention. Table 1 lists various propellants tested and shows exemplary rocket or engine parameters such as the initial port diameter, the port length, the oxidizer gas flow rate, the burn time, and the resultant regression rate. Relevant fuel variables for a number of propellants are shown in Table 2, and the entrainment onset parameters are shown. Those of skill in the art can easily obtain the physical parameters of other materials as such parameters are widely published in known references or experimentally determined. Further, guidance and direction are provided in

Figure 9, among others showing, the entrainment f the propellant as a function of the molecular weight. These are exemplary, and the Applicant respectfully submits that there is considerable teaching, guidance and direction in the specification and drawings on how to practice the claimed invention.

Based on the foregoing, Applicant respectfully submits that the application is now in condition for allowance. If any matters can be resolved by telephone, the Examiner is invited to call the undersigned attorney at the telephone number listed below. The Commissioner is authorized to charge any additional fees to Deposit Account No. 06-1300 (Order No. A-67587-1/AJT/MSS).

Respectfully submitted,



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VERSION WITH MARKINGS TO SHOW CHANGES MADE

Please amend the claims as follows:

14. (Twice Amended) A method of [selecting] combusting a propellant that exhibits desirable regression rate during combustion within a port having a gas stream flowing through the port, comprising the steps of:

[selecting] providing a propellant having under heat transfer from the gas stream flowing though the port, a liquid layer with surface tension σ and liquid viscosity μ_l values that promote entrainment of droplets from said liquid layer into said gas stream flowing in said port[;], and said propellant has an

[determining for the selected propellant] a $_{onset}$ value, where a $_{onset}$ is the entrainment onset parameter and is given by:

$$a_{onset} = 1.05 \times 10^{-2}[\rho_g^{1.3}/\rho_l^{0.3}][1/([Cf_{ref}]\,0.03\,C_{Bl})^{0.8}](1/\mu_g)\,\sigma\mu_l^{0.6};$$

where ρ_g is the [port] average [gas] density of the gas stream in the port, ρ_l is the [liquid] average density of the propellant in the liquid layer, [Cf_{ref} is the reference friction coefficient,] C_{Bl} is the blowing correction coefficient and is given by:

$$C_{Bl} = (2/2 + 1.25\,B^{0.75})$$

where $0 < B < 15$, and μ_g is the [port] mean gas viscosity of the gas stream in the port, and the units of a_{onset} is $kg^{1.6}/(m^{2.6}\text{-}sec^{1.6})$; [and]

flowing the gas stream through the port; and

combusting said propellant and gas wherein [selecting] said propellant has a value of [such that] a $_{onset}$ [has a value] that promotes entrainment of droplets from said liquid layer into said gas stream flowing in said port[, where the units of a_{onset} is $kg^{1.6}/m^{2.6}\text{-}sec^{1.6}$].

15. (Amended) The method of Claim 14 wherein a_{onset} is equal to or less than approximately 0.9 $kg^{1.6}/(m^{2.6}\text{-}sec^{1.6})$.

16. (Amended) The method of Claim 14 wherein the propellant is selected from [the] a n-alkane class of hydrocarbons, having the general formula of $C_n H_{2n+2}$ and mixtures thereof, where n is a mean carbon number and is in the range of 15 to 80, and which are solid at room temperature.

17. (Amended) The method of Claim 14 wherein the propellant is selected from [the] a group of alkhylnaphthalene compounds, anthracene, and mixtures thereof.

18. (Amended) The method of Claim 14 wherein the propellant is selected from [the] a group of organic acids having the general formula of $CH_3 (CH_2)_n COOH$ and mixtures thereof, where n is in the range of 8 to 25.

19. (Amended) The method of Claim 14 wherein the propellant is selected from [the] a group of n-paraffin compounds and mixtures thereof.

Cancel claim 20

21. (Amended) The method of Claim 14 wherein the propellant is selected from [the] a group of isomers of the alkane class of hydrocarbons.

Cancel claim 48.

Please add the following new claim:

49. (New) A method of combusting a propellant that exhibits desirable regression rate during combustion within a port having an oxidant flowing through the port, comprising the steps of:

flowing the oxidant through the port;

the propellant forming, under the heat transfer from the oxidant flowing through the port, a liquid layer having a liquid viscosity of less than about 1 milliPa-sec, and a surface tension of less

than about 25 milliN/m, such that droplets from said liquid layer are entrained in said oxidant; and

combusting said propellant and oxidant.